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OCR
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GCSE (9–1)

Examiners' report

MATHEMATICS

J560

For first teaching in 2015

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Version 1

ocr.org.uk/maths

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions, highlight good performance and where performance could be improved. A selection of candidate responses is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

Paper 4 series overview

Some candidates did not appear to read the questions carefully and use all the information or give the required answer. So, for example, in Question 3 we told them that *k* was a prime number, but many used 27 or 28 which are not prime numbers. In that question we asked for the smallest value of *N*, but many gave us the value of *k*. In Question 4 (e), candidates were asked for evidence, but many did not give us any. In Question 5 candidates were asked for the interest, but many instead gave the total investment.

It became obvious that most candidates knew the trigonometry formulae, but they were not able to use them in the correct situations, commonly using standard trigonometry in triangles with no right angles. It was also evident that many did not know what the variables in the kinematics formulae stand for, so they had difficulty in applying them.

Another common error made by candidates was truncating or rounding numbers too much and too soon in calculations, therefore leading to highly inaccurate answers.

Many candidates made errors in the questions at the beginning of paper. Particularly in Question 1 which was testing factorisation, many were not able to factorise, or they attempted to solve an equation which was not requested. Also, in Question 6 many attempted to draw 3-D drawings rather than the 2-D views requested.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• read the question carefully, used all the information given and gave the answer in the form requested • had good knowledge of trigonometry and when to use the sine and cosine rules • kept good accuracy in multiple calculations • used ratio in problems effectively • were able to form equations describing proportionality.	• did not use all the information given and they did not give the answer as requested in the question • attempted to use standard trigonometry in triangles with no right angle • would round or truncate numbers to very few figures which they would carry into further calculations • struggled to divide a total into two ratios correctly • struggled to form equations describing proportionality.

Question 1 (a)

1 Factorise fully.

(a) $6x^2 + 9x$

(a) ..... **[2]**

Some candidates did not understand what the term 'factorise' meant but, of those who did, many answered correctly. Some gave a partial factorisation such as $x(6x + 9)$.

Question 1 (b)

(b) $x^2 + 8x + 15$

(b) ..... **[2]**

This was usually answered well, although some attempted to solve the equation $x^2 + 8x + 15 = 0$, which was not was asked.

Question 2 (a)

2 You may use these kinematics formulae to answer these questions.

$v = u + at$

$v^2 = u^2 + 2as$

A moving particle accelerates at $2\,m/s^2$ for 8 seconds.
The particle's final velocity after the 8 seconds is 21 m/s.

(a) Show that the velocity of the particle at the start of the 8 seconds is 5 m/s. **[2]**

Many did not know which formula to use. Some attempted to use the second formula, which will not give the answer required. The information given were the values for *a*, *v* and *t*, but very few wrote down these variables.

Question 2 (b)

(b) Work out the distance travelled by the particle during the 8 seconds.

(b) ..... m **[3]**

The distance travelled, *s*, is only in the second formula, but many tried to use the first formula. As in part (a), there is a need for candidates to identify the variables given and those that are required.

Question 3 (a)

3 (a) N is a number such that:

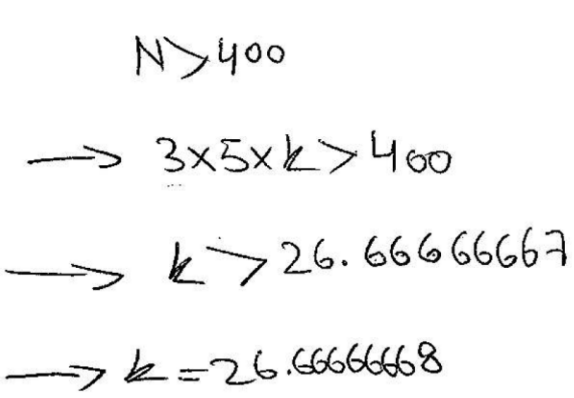
- $N = 3 \times 5 \times k$, where k is a prime number
- N is greater than 400.

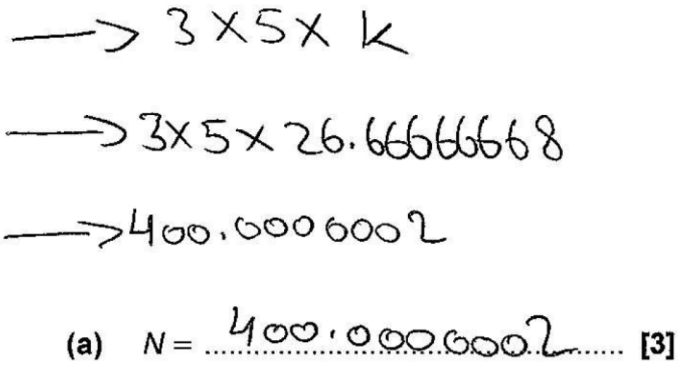
Find the smallest possible value of N.

(a) $N =$ ..... **[3]**

Some candidates did not use a prime number for k, so many gave the answer 405 from 3 × 5 × 27 or 420 from 3 × 5 × 28. Some even used a number that was not an integer.

Exemplar 1





(a) $N =$ 400.000600 2 **[3]**

Here the candidate has correctly found the decimal number that gives exactly 400, but they should have read the question again. All they need to do is find the smallest prime number larger than it and use that.

Question 3 (b)

(b) a and b are different prime numbers.

Explain why $a \times b$ is not a prime number.

.....

..... **[1]**

The common answers of 'there are more than 2 factors' or '$a \times b$ does not make a prime number' do not explain why ab is not prime. We need to say that a and/or b is a factor thus giving at least three factors.

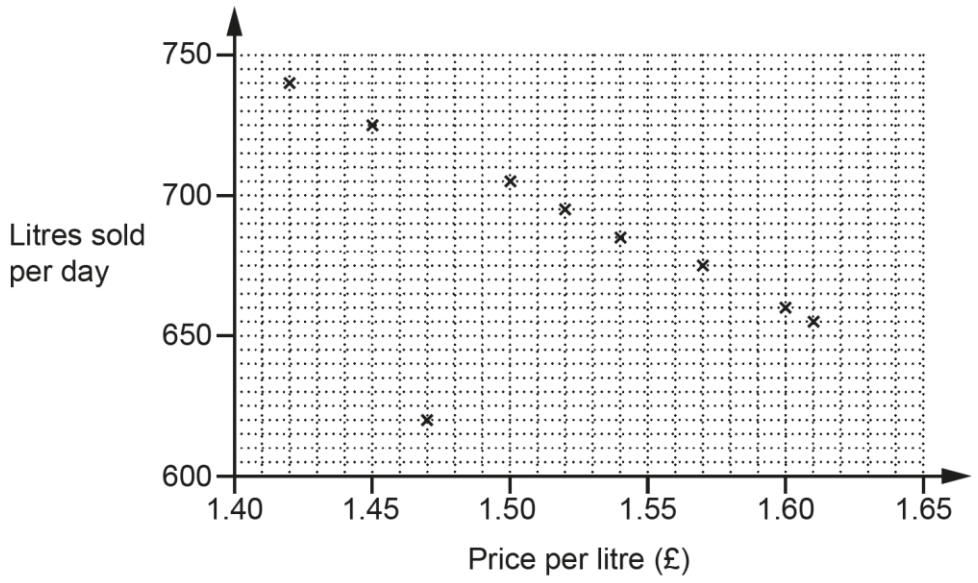
Question 4 (a)

4 Each week the manager of a petrol station records the average daily sales, in litres, and the average price, in pounds, of a litre of petrol for that week.

The table shows their results for ten weeks.

Week	1	2	3	4	5	6	7	8	9	10
Price per litre (£)	1.42	1.45	1.47	1.50	1.54	1.60	1.57	1.52	1.61	1.46
Litres sold per day	740	725	620	705	685	660	675	695	655	715

The results for the first nine weeks are plotted on the scatter diagram.



(a) Plot the result for week 10. **[1]**

Most plotted the point accurately. A few did not plot it at all.

Question 4 (b)

(b) Describe the type of correlation shown in the scatter diagram.

(b) ..... **[1]**

Most gave the correct answer, but a few wrote 'positive'.

Question 4 (c)

(c) In one week, there was a delay with petrol deliveries.

Circle the most likely point on the scatter diagram for that week. **[1]**

Most identified the outlier, while a few did not answer this part.

Question 4 (d) (i)

(d) (i) On the scatter diagram, draw a line of best fit. **[1]**

Most lines were acceptable and ruled, a few were at too great an angle or had a positive gradient.

Question 4 (d) (ii)

(ii) Use the line of best fit to estimate the average daily sales when the price per litre of petrol is £1.48.

(d)(ii) ..... litres **[1]**

Most candidates were able to read an acceptable value, a few were confused by the vertical scale.

Question 4 (e)

(e) The manager says,

As the sales go down, the total amount of money we take stays roughly the same.

Find evidence to support this statement.

.....

..... **[3]**

The question demand asked for evidence so most did use the points in the table to give readings with values that were broadly across the data set. Simple statements such as 'as the price goes down and the sales went up' did not give sufficient evidence.

Question 5

5 A person invests £8000 at a rate of 5% per year compound interest.

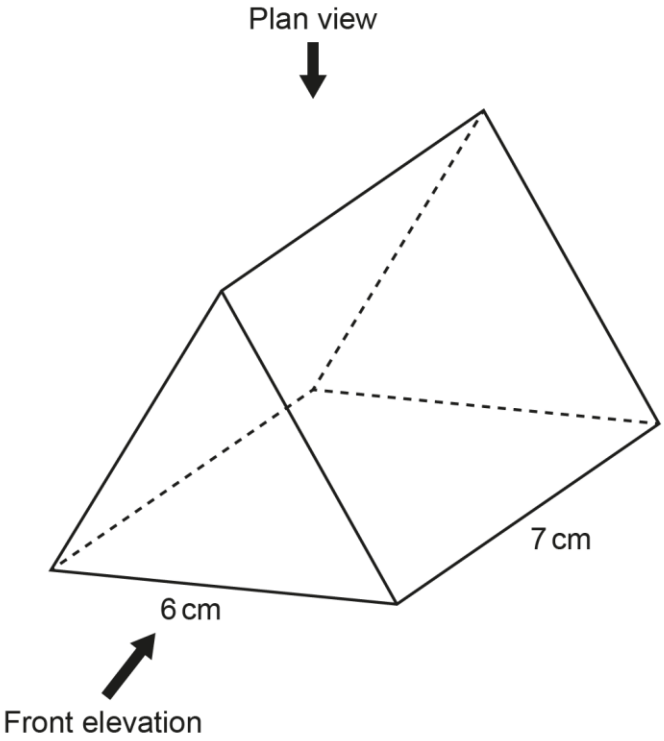
Calculate the total amount of **interest** earned after 3 years.

£ ..... **[3]**

This question was answered well but many gave the total investment not the interest alone. A few used simple interests which underlines the value of reading the question carefully.

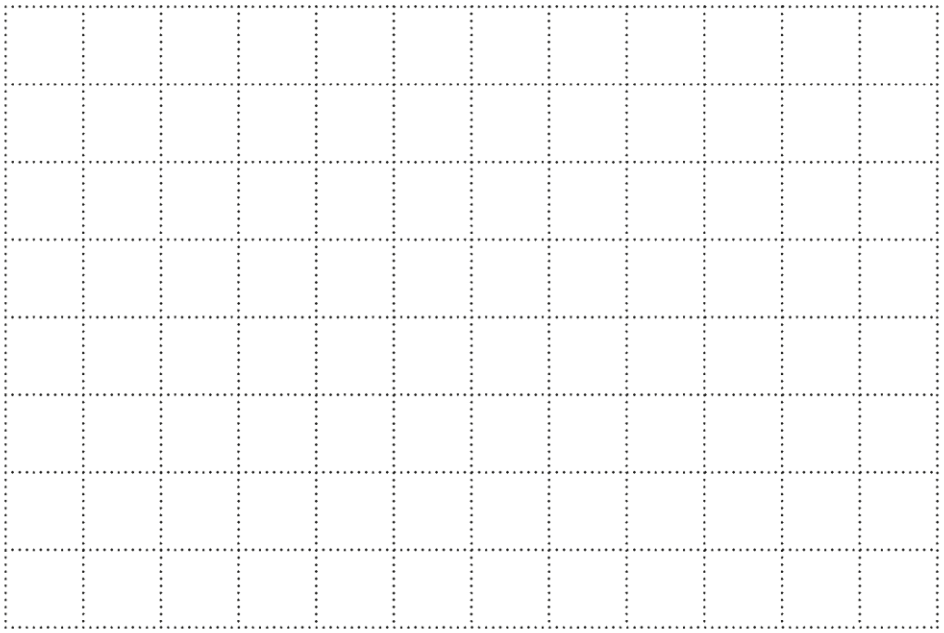
Question 6 (a)

6 The diagram shows an equilateral triangular prism.
Each side of the equilateral triangle is 6 cm and the length of the prism is 7 cm.



Not to scale

(a) Draw an accurate plan view of the prism on the one-centimetre square grid below.



[3]

Some gave 3-D diagrams, but we asked for a 2-D representation of the plan as seen from above. Some drew a rectangle measuring 7 cm by 6 cm without a line down the middle.

Question 6 (b)

(b) Draw an accurate front elevation of the prism on the one-centimetre isometric grid below.

[2]

The answer required should be a 6 cm equilateral triangle, many did draw an equilateral triangle but often measuring either 5 cm or 7 cm. Again, we saw some 3-D diagrams.

Question 7

7 A rock has a mass of 36 920 g and a volume of 14 200 cm^3.

Work out the density of the rock.
Give the units of your answer.

.... **[3]**

Many correctly divided 36 920 by 14 200 to get 2.6 but not all of them were able to give the units correctly, some giving g^2. Some candidates attempted to change the units to kilometres and kilograms, neither was requested and it was unnecessary work that made the question more difficult.

Question 8

8 There is a total of 354 balls in a bag.
There are white balls, red balls and green balls only.

The ratio of white balls to red balls is 3 : 4.
The ratio of red balls to green balls is 5 : 6.

Work out the number of green balls in the bag.

..... **[4]**

Many added the ratios so 5 + 6 = 11 and then they divided 354 by 11 and multiplied by 6. The key is to generate the ratio linking all three together by equating the red ball ratios of 4 and 5 so it was common to see 3 : 4 multiplied by 5 and 5 : 6 multiplied by 4.

Question 9

9 A cylinder has a radius of 8.4 cm.
The ratio of the radius of the cylinder to the height of the cylinder is 2 : 5.

Find the volume of the cylinder.

..... cm^3 **[4]**

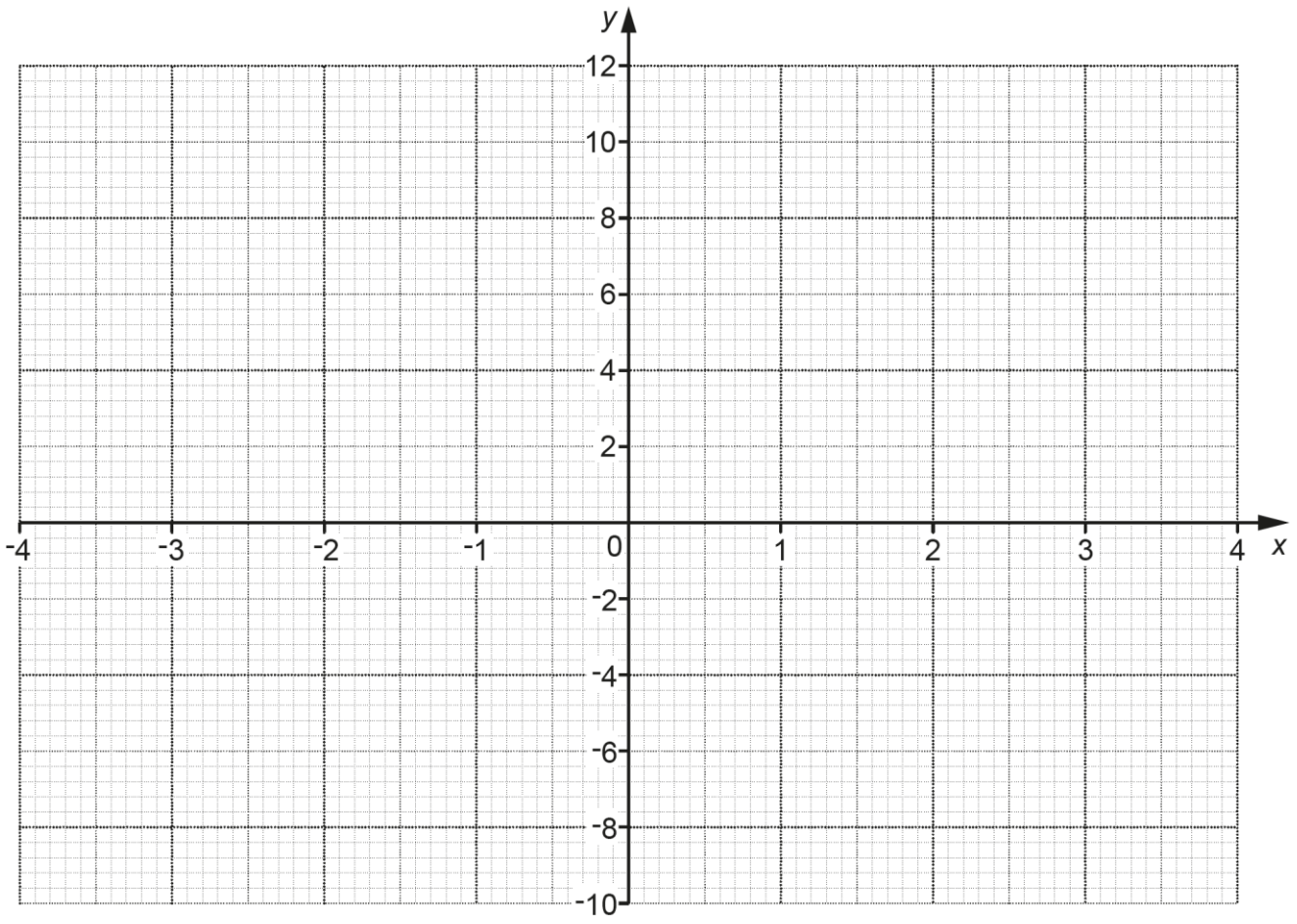
Many were able to find the height of 21 cm, but they could not use the correct formula for the volume of the cylinder.

Question 10 (a)

10 Here is a table of values for $y = x^2 - x - 8$.

x	-4	-3	-2	-1	0	1	2	3	4
y	12	4	-2	-6	-8	-8	-6	-2	4

(a) Draw the graph of $y = x^2 - x - 8$ for $-4 \leqslant x \leqslant 4$.



[3]

There were many candidates who left this question unanswered, those who plotted the points accurately did achieve some credit. The lines drawn did not always go through the points plotted and between $x = 0$ and $x = 1$ it is necessary to see the curve dip down and not be drawn as a horizontal line.

Question 10 (b)

(b) Write down the equation of the line of symmetry of the graph.

(b) ..... **[1]**

There were very few correct answers, many of the incorrect answers were not the equations of straight lines.

Question 10 (c)

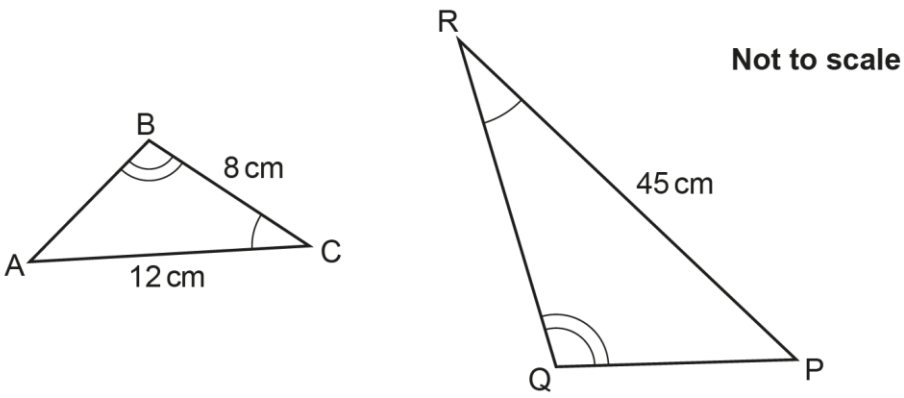
(c) Use the graph to solve the equation $x^2 - x - 8 = 0$.
Give your answers to **1** decimal place.

(c) $x =$ ..... or $x =$ ..... **[2]**

Those candidates who drew the graph correctly usually answered this part correctly as well, but some did give answers that showed they did not know where to find these answers, where the curve crosses the *x*-axis.

Question 11

11 Triangles ABC and PQR are mathematically similar.
Angle ACB = Angle PRQ.
Angle ABC = Angle PQR.



The perimeter of triangle PQR is 99 cm.

PQ = ... cm **[4]**

The common error was to attempt to use standard trigonometry to solve these triangles however none of the angles are right angles. The key term was 'mathematically similar', and many seemed to ignore this. Those who answered the question correctly usually gave the correct answer.

Question 12

12 y is directly proportional to the square of t.
$y = 14$ when $t = 2$.

t is directly proportional to x.
$t = 12$ when $x = 3$.

Find a formula for y in terms of x.
Give your answer in its simplest form.
You must show your working.

$y =$ ..... **[6]**

Many candidates did start to answer this question correctly, but they would often write the equations as, e.g. $t = kx$ and then give $k = 4$ but they did not write the complete equation $t = 4x$. These candidates would then find it difficult to combine the two equations.

Assessment for learning

The purpose of these questions is often to write out the equation linking two variables and that finding the value of the constant of proportionality, usually k, is not the end of the process.

Question 13

13 A water company is laying pipes to cover a distance of 37 metres, correct to the nearest metre.
Each pipe has a length of 2.3 metres, correct to 1 decimal place.
Assume the pipes are laid end to end with no gaps or overlaps.

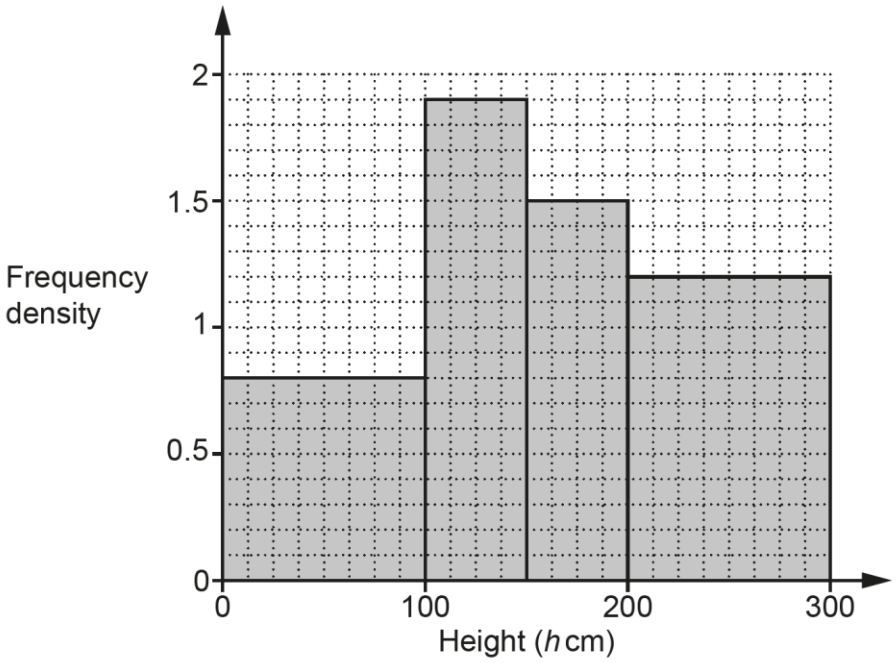
Work out the minimum number of pipes the water company needs to be sure of covering that distance.
You must show your working.

..... **[4]**

In this question the answer is not as important as the method used. Unfortunately, it is too easy just to do 37 ÷ 2.3 without using the appropriate bounds to ensure that the answer is accurate. Many did write down the bounds, but they would often choose the incorrect ones.

Question 14 (a)

14 The histogram summarises the heights, h cm, of some plants in a garden centre.



(a) Show that there are 80 plants with a height in the interval $0 < h \leqslant 100$. **[1]**

It was encouraging to see that many gave the correct answer to find the area of the bar, 0.8 × 100. Some gave no response to this question.

The purpose of part (a)

Part (a) may seem a simple question to ask at this point in the paper but it does have an important purpose. It is there to assist candidates to answer part (b) correctly and to remind them how to find the frequencies in a histogram.

Question 14 (b)

(b) The value, in pounds, of each plant depends on the plant's height.
The table below shows this information.

Height (h cm)	Value (£)
$0 < h \leqslant 100$	2.50
$100 < h \leqslant 150$	3.40
$150 < h \leqslant 200$	5.00
$200 < h \leqslant 300$	6.30

Use this information to find the **total** value of the plants represented in the histogram.

(b) £ ..... **[4]**

Some candidates who answered part (a) correctly, did not use the frequency of 80 here nor did they use the same method to calculate the other frequencies. Many did use the correct method of frequency × value but for the frequencies they would use either the group width of 100, 50, 50 and 100, the frequency calculated from the frequency density × 100 for each group or 80, 40, 40 and 80.

Exemplar 2

	Height (h cm)	Value (£)
0.8	$0 < h \leqslant 100$	2.50
1.9	$100 < h \leqslant 150$	3.40
1.5	$150 < h \leqslant 200$	5.00
1.3	$200 < h \leqslant 300$	6.30

Use this information to find the **total** value of the plants represented in the histogram.

0.8 x 100 = 80 x 2.50 = £200
1.9 x 100 = 190 x 3.40 = £646
1.5 x 100 = 150 x 5 = £750
1.3 x 100 = 130 x 6.30 = £819

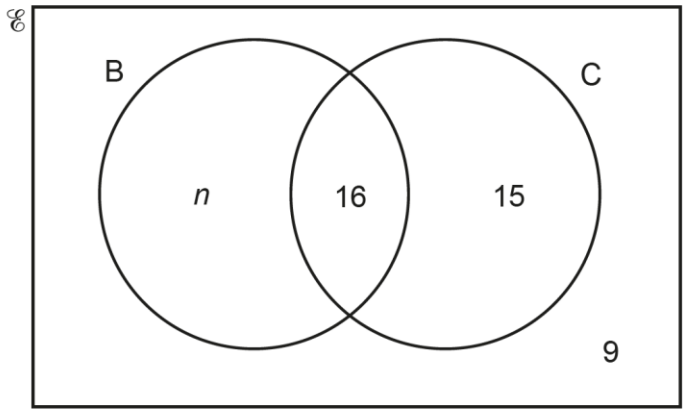
200 + 646 + 750 + 819 =
= £ 2415

(b) £ 2415 [4]

Here this candidate has answered part (a) correctly and uses 80 correctly but they have calculated the other three frequencies using 100 as the column width for all bars.

Question 15 (a)

15 In a survey, some students were asked whether they had travelled to school by bus (B) or by car (C) in the last week.
The Venn diagram shows some of the results.



(a) One of the students is chosen at random.
The probability that, in the last week, this student had travelled to school by bus and by car is $\frac{1}{4}$.

Find the value of n.

(a) $n =$ ..... **[3]**

The key in answering this problem is to link 16 with $\frac{1}{4}$ so finding the total of 64. Those who did usually found the correct answer. Some calculated $\frac{1}{4} \times (16 + 15 + 9)$ and gave the answer 10.

Question 15 (b)

(b) One of the students is chosen at random.

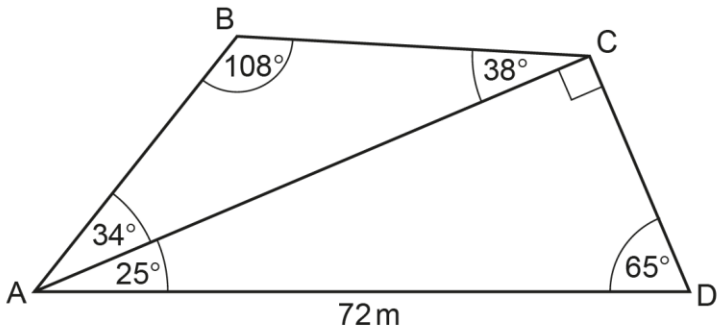
Find the probability that, in the last week, this student had travelled to school by car given that they had also travelled to school by bus.

(b) ..... **[2]**

Despite not getting the correct answer to part (a) many did give a fraction as an answer with 16 as the numerator thus gaining credit.

Question 16

16 AC is a diagonal of the quadrilateral ABCD.



Not to scale

AD = 72 m.
Angle ABC = 108°, angle BCA = 38° and angle BAC = 34°.
Angle ACD = 90°, angle CDA = 65° and angle CAD = 25°.

Find the area of ABCD.

..... m^2 **[6]**

Triangle ACD has a right angle so the use of sine or cosine is expected, and many candidates did do this. However, triangle ABC does not have a right angle, therefore, to solve this triangle they need to use either the sine rule, which was best choice here, or the cosine rule. The usual trigonometric functions are not valid in this triangle. Also, the length of side AC has to be calculated from triangle ACD and it must be used with sufficient accuracy in triangle ABC otherwise the answer calculated will be significantly different from the required accurate answer.

Question 17

17 An app's passcode consists of three digits. Each of the digits is a number from 0 to 9.
A digit can be used more than once.

Find the fraction of the possible passcodes that contain at least one 5.

..... **[4]**

Most candidates were unable to use the product rule to find the total number of different passcodes. Some thought that the number of digits from 0 to 9 was 9. The common approach was to start to write down some possibilities including 5 but these responses were generally unfinished.

Question 18 (a)

18 Some sequences are defined using this term-to-term rule.

$u_{n+1} = 5u_n - 8$.

(a) If $u_3 = 22$, show that $u_4 = 102$. **[1]**

This question was aimed at those aiming for the highest grades and many candidates did not attempt it. Those who did often made a good attempt at this part and showed the necessary working of 5 × 22 – 8.

Question 18 (b)

(b) If $u_3 = 22$, work out u_2.

(b) ..... **[3]**

Part (a) was designed to help scaffold this part, where candidates were expected to write an equation $22 = 5u_2 - 8$ and then rearrange it to find u_2.

Question 18 (c)

(c) If $u_1 = 2$, write down the value of u_{50}.
Give a reason for your answer.

u_{50} = ... because .....

..... **[2]**

As in part (a) it was hoped that many would calculate 5 × 2 – 8 = 2. Indeed, some did do this. However, a common error was candidates noticing that u_1 was 2 × 1, leading to a lot of $u_{50} = 2 \times 50 = 100$ as the answer.

Question 19

19 Two ornaments, A and B, are mathematically similar.
The table shows information about the two ornaments.

	Ornament A	Ornament B
Height (m)	h	12
Surface area (m^2)	216	A
Volume (m^3)	240	3750

Find the value of h and the value of A.
You must show your working.

$h =$ .....

$A =$ ..... **[6]**

Many calculated the scale factor of volume as 3750 ÷ 240 or 15.625 and then they would use this to calculate the missing values. They needed to first calculate the scale factor of length by working out $\sqrt[3]{15.625}$.

Question 20 (a)

20 **(a)** Show that the equation $x^3 - 3x - 4 = 0$ has a solution between $x = 2$ and $x = 3$. **[3]**

This question was similar to others we have set on this topic, here in part (a) we just need the values to be calculated by substituting both $x = 2$ and $x = 3$ into the function and noticing the change of sign. Some started to evaluate other values for x between 2 and 3 and this was unnecessary extra work.

Question 20 (b)

(b) Use $x = 2.5$ to find a smaller interval for the solution to $x^3 - 3x - 4 = 0$.
You must show your working.

(b) ..... **[2]**

Candidates needed to substitute x = 2.5 and look at the sign, then pick the two values with a sign change. Many did the substitution and gave the correct value but did not progress further.

Question 20 (c)

(c) Find this solution correct to **1** decimal place.
You must show your working.

(c) $x =$ ..... **[3]**

Here was the part to start evaluating the function for values of x between 2 and 2.5. Many candidates did not attempt this part, but a few did give the correct answer.

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